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(54) **Improvements in continuous vacuum crystallisers**

(57) A continuous crystalliser preferably a vacuum crystalliser is shown having particular application to the sugar production and refining industry. The crystalliser comprises a vertically disposed cylindrical vessel 10 in which there are a series of sector shaped cells 38-52 defined by partitions 22-36 radially disposed about the axis of the vessel. Each cell is provided with an inlet eg 72 for molasses. A calandria is provided for heating the massecuite in each cell. Seed crystals are introduced into the massecuite in a first cell and the massecuite passes from cell to cell in a generally circular path through the vessel before passing through an outlet 78 in a cell adjacent the first cell but isolated therefrom.

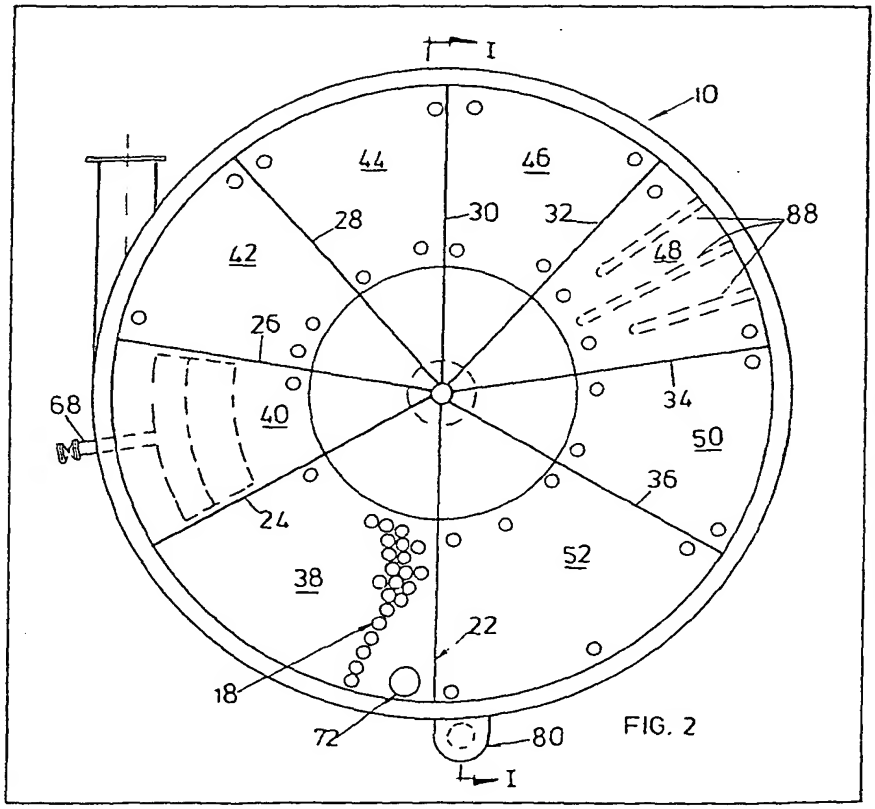

FIG. 2

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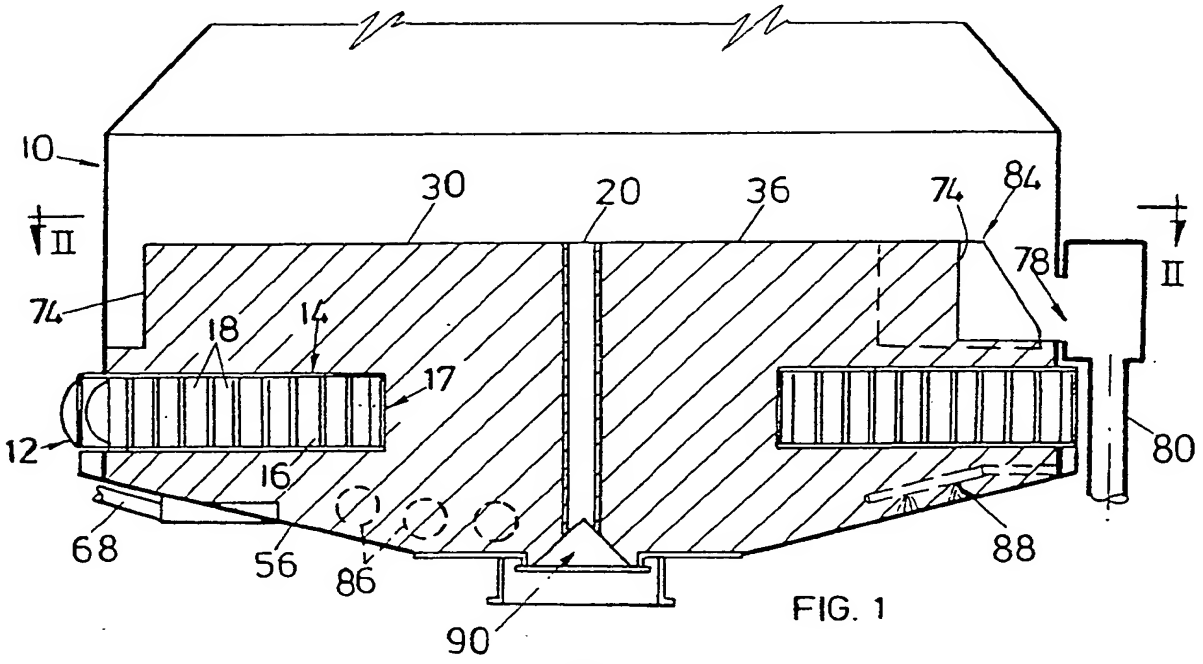

FIG. 1

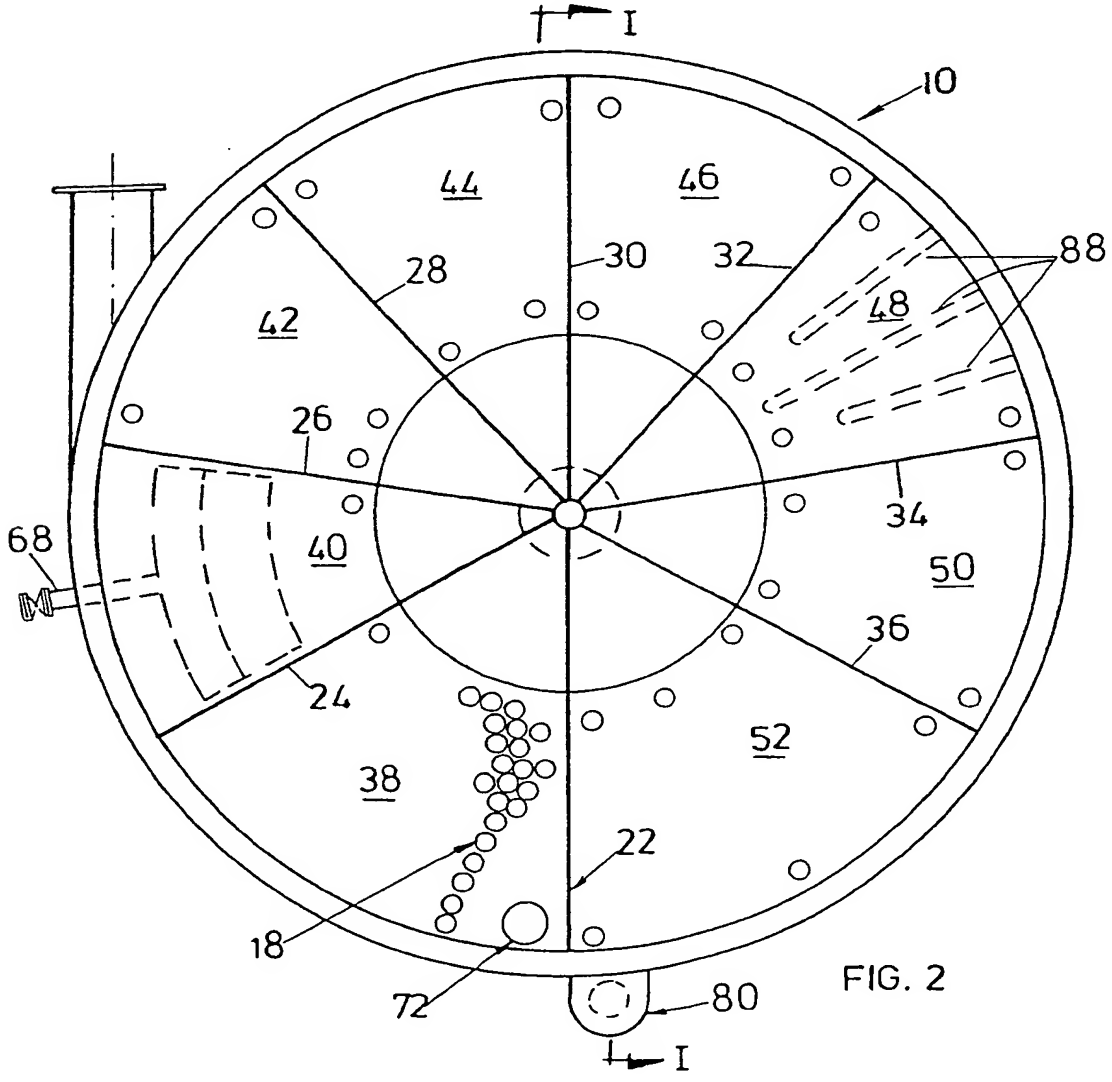

FIG. 2

SPECIFICATION

Improvements in continuous vacuum crystallisers

Background of the invention

This invention relates to the continuous crystallisation of the solute of a solution and has particular application to the continuous crystallisation under vacuum of sugar from syrup or molasses in the production and refining of sugar.

A known crystalliser comprises a cylindrical body disposed with its axis horizontal and divided into a series of compartments or cells. Hot molasses or syrup (a concentrated sugar solution) and fine grain seeding are introduced into a cell at one end of the vessel and the massecuite (a mixture of crystals and mother liquor) passes along the crystalliser from cell to cell. Heating means are provided in the cells as well as feed means for feeding more molasses or syrup into each cell. Sugar crystals are formed in or introduced to the first cell and these increase in size as the massecuite carrying the already formed crystals passes from cell to cell.

The formation and growth of the crystals is controlled by the rate of flow of the massecuite through the crystalliser, the rate of feed of molasses or syrup, the temperature in ech cell and also by the heat input to each cell.

In known crystallisers of the abovedescribed type the flow of the molasses and the crystals may be sinuous from cell to cell but the mass flow through the vessel as a whole is generally linear i.e. in a straight line from one end of the vessel to the other, or if there is a central division from one end to the other and back again.

Another known type of crystalliser comprises a cylindrical vessel disposed with its axis vertical. This is however essentially a batch type i.e. discontinuous crystalliser, being designed so that crystals from a batch which having been grown to the required size must first be removed in toto before the vessel can be recharged. Having regard to the advantages of continuous crystallisation, it is an object of the present invention to provide a continuous crystalliser which can use a vessel similar to that used in a batch-type crystalliser of the type described above.

Summary of the Invention

According to the invention there is provided apparatus for the continuous crystallisation of the solute of a solution, the apparatus comprising a vessel in which are located a number of cells including a first cell provided with inlet means through which solution and seed can be fed into the first cell, at least one intermediate cell provided with inlet means for feeding solution into the intermediate cell, and a last cell provided with outlet means through which the mixture of solution and solute can be removed from the last cell, and heating means for heating the solution and crystallised solute in each cell, the cells being so arranged that the solution and crystallised solute will flow in a generally circular path from the first cell via the intermediate cell or cells to the last cell.

According to one aspect of the invention, the vessel is cylindrical and is arranged so that in use its longitudinal axis will be upright.

In one form of the invention the cells are substantially sector shaped and are disposed about a common centre.

According to a further aspect of the invention at least two of the cells are separated by a partition which is provided with weir means over which solution and crystallised solute can flow from the one cell to the other.

Advantageously the weir means is provided with a gate element for controlling the flow of the solution and crystallised solute from one cell to the other.

According to an alternative aspect of the invention at least two of the cells are separated by a partition and a passage is provided adjacent a low part of the partition through which solution and crystallised solute can flow from one cell to he other.

Brief Description of the Drawings

The invention is further disclosed with reference to the accompanying drawings, in which

Figure 1 is a somewhat schematic sectional elevation on arrows I-I in Figure 2; and

Figure 2 is a similarly schematic sectional plan view on arrows II-II in Figure 1.

In the drawings there is shown a vacuum crystalliser comprising a vessel 10 which is cylindrical and is in use disposed with its longitudinal axis vertical. The upper part of the vessel is not shown in the drawings since it is not material to the present invention but it is provided with conventional means for putting the interior of the vessel under vacuum and for removing vapour given off by the contents of the vessel.

Located in the lower portion of the vessel 10 is a calandria 12 of conventional construction. The calandria comprises two annular tube plates 14 and 16 located one above the other and welded at their outer peripheries to the outer wall of the vessel 10. Furthermore their outer peripheries are joined by a vertical wall 17 so that the space between the tube plates 14 and 16 is sealed from the contents of the vessel 10. The tube plates are joined by vertically disposed tubes 18 through which the contents of the vessel 10 can flow. The tubes are heated by steam which enters the space between the tube plates 14 and 16 and flows around the outside of the tubes 18. Condensate and incoadensible gases are exhausted through suitable outlets which are not shown in the drawings. By this means matter flowing through the bores of the tubes is heated by the tubes.

A series of vertical plates, extending radially outwardly from the centre of the vessel are located in the lower part of the vessel 10. These plates constitute partitions 22 to 36 inclusive which divide the lower part of the interior of the vessel 10 into a series of sector shaped cells 38 to 52. Molasses is fed into each cell via valved pipies 68, only one such pipe (for feeding the cell 40) being shown.

The partition 22 completely isolates the first cell 38 from the last cell 52. An inlet pipe 72 is provided in the floor 56 of the first cell 38. This inlet pipe is used for the introduction of seed into the first cell 38. The partitions 24 to 36 inclusive, i.e. all partitions except the partition 22 are provided with cut outs 74 where their upper and outer edges meet the wall of the

vessel. Thus massecuite can flow from the first cell through the intermediate cells to the last cell via the cut out 74 in each case. An outlet aperture 78 is formed in the wall of the vessel in the last cell 52. This aperture is located so that solute in the last cell 52 can flow out of the aperture 78 into a take-off and pipe 80.

The mass flow of the massecuite through the vessel is thus in a substantially circular path.

The cut outs 74 constitute weirs over which the massecuite flows from cell to cell. The flow can optionally be controlled at each cut out by means of gates only one of which is shown in the form of a plate 84 the position of which can be adjusted to vary the size of the cut out.

If desired apertures shown in dotted outline at 86 can be provided throughselected ones of the partitions 24 to 36 (for example every second partition) at a position close to the floor 56 of the vessel. Alternatively these selected partitions can terminate above the floor 56. In either case this allows flow of the massecuite between one cell and another at a level at or close to the floor.

Steam blow pipes 88 are provided for assisting the flow of the mass through the vessel and promoting a more vigorous boiling action. The function of these pipes is well understood by those skilled in the art.

The particular vessel 10 shown in the drawings is the vessel of a converted batch-type crystalliser as previously described. The vessel 10 has a discharge outlet which, for continuous crystallisation, is provided with a closure device 90 which under normal operating conditions, is opened only for emptying the pan contents at the conclusion of an operation period and for maintenance purposes.

CLAIMS

1. Apparatus for the continuous crystallisation of the solute of a solution, the apparatus comprising a vessel in which are located a number of cells including a first cell provided with inlet means through which solution and seed can be fed into the first cell, at least one intermediate cell provided with inlet means through which solution can be fed into the intermediate cell, and a last cell provided with outlet means through which the mixture of solution and solute can be removed from the last cell, and heating means for heating the solution and crystallised solute in each cell, the cells being so arranged that the solution and crystallised solute will flow in a generally circular path from the first cell via the intermediate cell or cells to the last cell.

2. Apparatus according to claim 1 in which the vessel is cylindrical and is arranged so that in use its longitudinal axis will be upright.

3. Apparatus according to claim 1 or claim 2 in which the cells are substantially sector shaped and are disposed about a common centre.

4. Apparatus according to any one of the preceding claims, in which at least two of the cells are separated by a partition which is provided with weir means over which solution and crystallised solute can flow from the one cell to the other.

5. Apparatus according to claim 4 in which the weir means is provided with a gate element for controlling the flow of the solution and crystallised solute from the one cell to the other.

6. Apparatus according to any one of claim 1 to 3 in which at least two of the cells are separated by a partition and a passage is provided adjacent a low part of the partition through which solution and crystallised solute can flow from one cell to the other.

7. Apparatus for the continuous crystallisation of sugar crystals from sugar liquors or molasses, substantially as herein described.

8. Apparatus for the continuous crystallisation of sugar crystals from sugar liquors or molasses, substantially as described with reference to the accompanying drawings.

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